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# Posttraumatic Stress Disorder Following Assault: The Role of Cognitive Processing, Trauma Memory, and Appraisals

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Two studies of assault victims examined the roles of (a) disorganized trauma memories in the development of posttraumatic stress disorder (PTSD), (b) peritraumatic cognitive processing in the development of problematic memories and PTSD, and (c) ongoing dissociation and negative appraisals of memories in maintaining symptomatology. In the cross-sectional study ($n = 81$), comparisons of current, past, and no-PTSD groups suggested that peritraumatic cognitive processing is related to the development of disorganized memories and PTSD. Ongoing dissociation and negative appraisals served to maintain PTSD symptoms. The prospective study ($n = 73$) replicated these findings longitudinally. Cognitive and memory assessments completed within 12-weeks postassault predicted 6-month symptoms. Assault severity measures explained 22% of symptom variance; measures of cognitive processing, memory disorganization, and appraisals increased prediction accuracy to 71%.

Posttraumatic stress disorder (PTSD) is characterized by recurrent, intrusive memories of a highly distressing traumatic event. These recollections tend to be vividly sensory, are experienced as relatively uncontrollable, and evoke extreme distress. The individual may lose the capacity to distinguish the memory from current perceptions, and the event is re-experienced as a flashback. Unwanted memories may be uncontrollably triggered by a variety of trauma-related cues. The accompanying fear and distress are sufficient to stimulate substantial efforts (both overt and covert) to avoid recalling the event.

Theories of PTSD have linked re-experiencing symptoms to more pervasive disturbances in autobiographical memory for the trauma (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000; Foa, Steketee, & Rothbaum, 1989). The symptoms of PTSD include an "inability to recall an important aspect of the trauma" (American Psychiatric Association, 1994, p.428), and research suggests that intentional recall of traumatic experiences is impaired relative to recall of nontraumatic events (Byrne, Hyman, & Scott, 2001; Tromp, Koss, Figueredo, & Tharan, 1995). Clinically, trauma-exposed individuals may recall some aspects of the trauma with exceptional clarity, but the overall memory structure is often confused, with uncertainty relating to the sequence of events and important aspects of the trauma that cannot be recalled at all. There is preliminary evidence that the degree of such disorganization is related to the development of PTSD (Amir, Stafford, Freshman, & Foa, 1998; Gray & Lombardo, 2001; Murray, Ehlers, & Mayou, 2002) and acute stress disorder (Harvey & Bryant, 1999). Thus, theorists have addressed two basic questions. First, how do disorganized trauma memories lead to PTSD symptoms? Second, why are trauma memories laid down in a disorganized way?

Theories of PTSD have linked problems in recalling the trauma to the occurrence of intrusive memories, both these phenomena being a consequence of the way that trauma memories are encoded (e.g., Brewin et al., 1996; Ehlers & Clark, 2000; van der Kolk, 1994). Ehlers and Clark (2000) drew on current theories of autobiographical memory to explain the association between disorganized trauma memories and PTSD symptoms. Storage of autobiographical events is thought to occur through associations with thematically and temporally related experiences within the autobiographical memory base: To the extent that elaboration increases the number of such associations, it facilitates intentional retrieval of memories through higher order search strategies and simultaneously inhibits direct, lower level retrieval through matching sensory cues (Conway, 1997; Conway & Pleydell-Pearce, 2000). Thus, if trauma memories are poorly elaborated within the autobiographical memory base (i.e., have relatively few associations with other stored information), in addition to impairing intentional retrieval, this will render memories more vulnerable to triggering by matching sensory cues, increasing the frequency of intrusive symptoms.

In seeking to explain how disorganized trauma memories develop, trauma theorists have proposed that the overwhelming nature of traumatic events results in disruptions in peritraumatic cognitive processing (e.g., Brewin et al., 1996; Ehlers & Clark, 2000; Horowitz, 1976; van der Kolk & Fisler, 1995). In this regard, most theories have focused on the role of dissociation: Peritraumatic dissociation has been found to be associated with disorganized narratives of the trauma (Harvey & Bryant, 1999;

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Murray et al., 2002) and to predict subsequent symptomatology (Ehlers, Mayou, & Bryant, 1998; Koopman, Classen, & Spiegel, 1994; Murray et al., 2002; Shalev, Peri, Canetti, & Schreiber, 1996). However, the concept of dissociation is complex and includes a range of different components, such as reduced awareness of one's surroundings, derealization, depersonalization, and emotional numbing. Not all of these aspects will be equally important for the development of disorganized trauma memories. Although it has been proposed that a narrowing of attentional focus (absorption) or a more pervasive disengagement from internal and external contexts may explain encoding deficits (Butler, Duran, Jasiukaitis, Koopman, & Spiegel, 1996; Easterbrook, 1959; Spiegel, 1995), these specific hypotheses remain untested.

Ehlers and Clark (2000) therefore applied experimental psychology research on the relationship between information processing during encoding and the quality of subsequent memories to PTSD. Two cognitive-processing dimensions are proposed to (a) overlap with dissociation, bringing the dissociative construct closer to research in experimental psychology, and (b) to be instrumental in the development of PTSD.

First, it is proposed that individuals who engage primarily in surface level, data-driven processing (i.e., processing sensory impressions and perceptual characteristics) during trauma and carry out relatively little elaboration of the contextual and meaning elements of the event are at greater risk of developing PTSD than those who engage in relatively less data-driven processing and more in-depth, elaborative processing (see also Spiegel, 1995). This hypothesis is based on research indicating that data-driven processing results in a poorly elaborated, perceptually encoded memory trace (Roediger, 1990). Preliminary evidence for the role of data-driven processing in the development of PTSD was found in two prospective studies of motor vehicle accident survivors (Murray et al., 2002; Rosario, Williams, & Ehlers, 2001) and in experimental analogue studies (Halligan, Clark, & Ehlers, 2002).

Second, it is proposed that an inability to establish a self-referential perspective during the trauma impedes the integration of memory into the autobiographical memory base. A "self-referent perspective" involves processing experiences with respect to oneself and relating them to other autobiographical information. Disruptions in self-referent processing may be conceptually similar to depersonalization (a dissociative phenomenon), but the latter involves more extreme disconnectivity (e.g. out-of-body experiences). The hypothesized role of insufficient self-referent processing in the formation of trauma memories is based on recent research suggesting that autobiographical memory is organized around a sense of self (Howe & Courage, 1993; Wheeler, Stuss, & Tulving, 1997).

Whether cognitive processing and trauma memory deficits predict longer term PTSD symptoms will be determined by the presence of maintaining factors. The present research considers two potential maintaining factors. First, persistent dissociation has often been associated with PTSD and implicated in the maintenance of the disorder. If an individual dissociates while recalling the trauma, this may impede cognitive and emotional processing of the event (Foa & Hearst-Ikeda, 1996; van der Kolk & Fisler, 1995). In support of this proposed role in the maintenance of PTSD, Murray et al. (2002) found that persistent dissociation at 4 weeks posttrauma was a better predictor of long-term PTSD severity than peritraumatic dissociation. Second, there is accumulating evidence that an individual's interpretation of their PTSD symptoms plays a major role in maintaining PTSD (Clohessy & Ehlers, 1999; Dunmore, Clark, & Ehlers, 1999, 2001; Ehlers et al., 1998; Steil & Ehlers, 2000). Prior studies have mainly concentrated on the interpretation of intrusive symptoms. The present studies included measures of the individual's interpretation of difficulties in recall as well as interpretations of intrusive memories.

The present studies were designed to investigate the role of cognitive processing (dissociation, data-driven processing, self-referent processing) during trauma and deficits in intentional recall in the development of PTSD symptoms following assault. In addition, the relationship of the processing variables both to each other and to memory deficits was examined; to our knowledge, no previous study has specifically addressed this question. Finally, we investigated the role of persistent dissociation and interpretations of trauma memories in maintaining PTSD symptoms. The results of two studies of survivors of assault are presented. Study 1 used a cross-sectional design, and Study 2 attempted to replicate and extend the findings in a prospective longitudinal investigation. The following hypotheses were addressed:

> Cognitive processing during trauma (dissociation, data-driven processing, self-referent processing) is related to disorganized trauma memories.
>
> Cognitive processing and disorganized trauma memories predict severity of subsequent PTSD symptoms.
>
> Persistent dissociation explains the severity of chronic PTSD symptoms over and above peritraumatic cognitive processing.
>
> Excessively negative appraisals of intrusive memories and memory deficits predict the severity of chronic PTSD symptoms, over and above cognitive processing and memory deficit measures.

In addition, we investigated whether these cognitive factors predict the severity of chronic PTSD symptoms over and above measures of assault severity.

## Study 1: Cross-Sectional Study

### *Method*

#### *Experimental Design*

Study 1 examined the role of cognitive variables in the development of PTSD in a cross-sectional sample of assault survivors. PTSD symptoms were assessed both currently (i.e., at the time of the interview) and (retrospectively) for a month after the assault. This allowed us to distinguish between three groups of participants: participants with current PTSD, participants who had recovered from PTSD, and participants who never developed PTSD. For variables that contribute to the initial development of PTSD, both the current and the recovered PTSD groups should score higher than the no-PTSD group. In the present study, this pattern of results was predicted for the cognitive processing during assault measures and the trauma memory deficit measures. For variables that contribute to the maintenance of PTSD, the current PTSD group should score higher than both the no-PTSD and recovered PTSD groups. This pattern of results was expected for measures of persistent dissociation, and appraisals of trauma memory deficits.

## Participants

Male and female victims of assault were recruited through Victim Support Schemes. Victim Support Schemes contact all victims of crime who report the incident to the police, to offer them support. Victim Support Schemes sent information about the study to all victims of assault during the study period. Respondents were excluded from the study following a telephone screening if those screened were under 18 years or more than 75 years of age, were assaulted in the context of ongoing domestic violence, had a history of psychosis, or had a current substance abuse problem. The U.K. Multicenter Research Ethics Committee approved the study, and all participants gave written informed consent prior to participation.

The sample for Study 1 comprised 81 victims of physical or sexual assault (33 female, 48 male), who had been assaulted more than 3 months previously. Participants were grouped according to their PTSD symptomatology: the current PTSD group ($n = 32$) met criteria for PTSD at the time of interview; the recovered PTSD group ($n = 20$) met criteria for PTSD 1-month postassault, but not at interview; the no-PTSD group ($n = 29$) did not meet criteria for PTSD subsequent to the assault.

## Symptom Measures

*Posttraumatic stress disorder.* The Posttraumatic Stress Diagnostic Scale (PDS; Foa, 1995; Foa, Cashman, Jaycox, & Perry, 1997) is a standardized self-report measure of PTSD diagnostic criteria, including trauma characteristics, symptom severity and duration, and resultant degree of life interference. The PDS was administered with the assistance of the interviewer, who clarified items as required. The PDS has acceptable levels of reliability and validity and shows good diagnostic agreement with the Structured Clinical Interview for *DSM–IV* (Foa et al., 1997). To be given a positive diagnosis, individuals needed to score at least 15 on the PDS symptom scale, in addition to meeting *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; American Psychiatric Association, 1994) criteria, as research indicates that the inclusion of this severity cutoff improves agreement between PDS and diagnostic interview derived diagnoses (Foa, 1998). Participants completed two versions of the PDS: the first assessed symptom severity at the time of the interview, and the second retrospectively assessed symptom severity at 1-month postassault.

*Depression and anxiety.* The Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) and the State–Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) are standardized measures of depression and anxiety, respectively.

## Demographic and Assault Characteristics

A semistructured interview, adapted from Dunmore et al. (1999, 2001), was used to obtain demographic information, a brief psychiatric history, and a comprehensive assessment of assault characteristics. Objective assault severity was computed as a composite score of the following severity indices; number of assailants, assault duration, use of verbal threat, injury severity, and weapon usage (Dunmore et al., 1999). Subjective severity of the assault was assessed in terms of degree of threat perceived and resultant fear. Participants rated their perceived physical threat during the assault on 0% to 100% probability scales (perceived threat to life/of serious injury, two scales, $\alpha = .74$). Fear during the assault was assessed through participant ratings of their agreement with several descriptors of fear/terror, on 0–4-point Likert-type scales (*I felt terrified/ alarmed/ shocked/ anxious*; four items, $\alpha = .83$).

## Cognitive Processing Measures

*Cognitive processing during assault.* Self-report measures of cognitive processing during trauma were developed in a series of studies (Dunmore et al., 1999, 2001; Halligan et al., 2002; Murray et al., 2002; Rosario et al., 2001). For each scale, participants rated their agreement with each item on a 0–4-point Likert-type scale.

Dissociation during assault was measured with the State Dissociation Questionnaire (SDQ). This is a nine-item scale originally developed by Murray et al. (2002), measuring peritraumatic dissociative experiences such as derealization, depersonalization, detachment, altered time sense, and emotional numbing. The SDQ was developed in a series of studies with trauma survivors and student volunteers and shows good reliability and validity (Halligan et al., 2002; Murray et al., 2002). It correlates highly with the Peritraumatic Dissociation Scale (Marmar, Weiss, & Metzler, 1997), $r = .79$ (Rosario et al., 2001). The internal consistency in the present samples of assault survivors was $\alpha = .91$.

Data-driven processing was measured with the Data-Driven Processing Scale (Ehlers, 1998). This eight-item scale assesses the extent to which participants primarily engaged in surface level, perceptual processing during the assault (e.g. "It was just like a stream of unconnected impressions following each other;" eight items, $\alpha = .88$). The Data-Driven Processing Scale has previously been shown to have satisfactory to good internal consistencies in patient and student populations (Cronbach's alphas of .7 and above; Ehlers, 1998), to predict both narrative disorganization and the development of PTSD in prospective studies of motor vehicle-accident victims (Murray et al., 2002; Rosario et al., 2001), and to predict the development of analogue PTSD symptoms and disorganized narratives following exposure to a distressing videotape (Halligan et al., 2002).

Self-referent processing was measured with the Lack of Self-Referent Processing Scale, developed for the study, a self-report measure which assesses the extent to which participants processed the assault as happening to themselves and incorporated the experience with other autobiographical information relating to the self (e.g., "I felt as if it was happening to someone else," "I felt cut off from my past;" eight items, $\alpha = .88$). A higher score on this questionnaire indicates less self-referent processing. The scale has been demonstrated to predict the development of PTSD symptoms in survivors of motor vehicle accidents (Rosario et al., 2001).

*Persistent dissociation at time of interview.* Persistent dissociation was measured with the Trait Dissociation Questionnaire (TDQ; Murray et al., 2002). The TDQ comprises 38 items selected from an initial pool of 101 items. Items were taken from existing dissociation measures (Bernstein & Putnam, 1986; Koopman et al., 1994; Marmar et al., 1997; Sanders, 1986) or were new items assessing previously underrepresented aspects of dissociation that appear to be relevant to PTSD (primarily emotional numbing; Foa & Hearst-Ikeda, 1996). Murray et al. (2002) described data supporting the reliability and validity of the TDQ. In student and patient samples, the internal consistency of the total score was above Cronbach's $\alpha = .90$ and the retest reliability above $r = .80$. TDQ scores predicted chronic PTSD in motor, accident survivors (Murray et al., 2002). Factor analyses indicated that the TDQ measures seven aspects of dissociation: detachment from others and the world, sense of split self, labile mood and impulsiveness, inattention and memory lapses, emotional numbing, confusion and altered sense of time, and amnesia for important life events.

## Memory Measures

*Self-reported characteristics of trauma memories.* The Trauma Memory Questionnaire asks participants to describe their trauma memories. It consists of two subscales. Disorganization items assess deficits in intentional recall, that is, the extent to which memory for the trauma is disorganized or incomplete (e.g., "I cannot get what happened during the assault straight in my mind"; five items, $\alpha = .88$). Intrusion items assess the extent to which trauma memories have strong perceptual elements, are easily triggered or uncontrollable, and are accompanied by a sense of reliving the event (eight items, $\alpha = .90$). Disorganization and intrusion items on this questionnaire have previously been demonstrated to relate to cognitive processing and PTSD symptomatology in the context of experimental analogue studies (Halligan et al., 2002).

*Assault recall task.* Participants were asked to give a detailed verbal narrative of the assault. They were instructed to recall the assault as vividly, clearly, and in as much detail as possible, describing events in the order in which they occurred. The experimenter did not interrupt participants during the recall task. Following recall, participants rated any distress in response to the task, on a 0–100-point visual–analogue scale.

Narratives were transcribed verbatim and then scored by Sarah L. Halligan. Scoring began with the first expression of threat in the narrative, and ended with the termination of immediate threat. Scoring followed rules developed by Foa, Molnar, and Cashman (1995). Narratives were divided into "chunks" or clauses containing "only one thought, action, or speech utterance." Three indices of memory disorganization were assessed: (a) clauses consisting of repetitions; (b) clear expressions of uncertainty with regards to memory, confusion, or nonconsecutive chunks (e.g., "I know something didn't, at least, they were broken"); and (c) clauses indicating understanding of what was happening (reversed). Each score was *z* transformed. The memory disorganization score was calculated as $z(1) + z(2) - z(3)$. In addition, the rater gave a global rating of coherence, from 0 (*not at all disorganized*) to 10 (*extremely disorganized*) after carefully reading each narrative (similar to Murray et al., 2002). Narratives were rated from anonymously coded transcripts and the rater was unaware of the participants' symptom scores. However, Sarah L. Halligan had interviewed about half of the participants for whom transcripts were available (Studies 1 and 2). A second rater (David M. Clark), who had not done any of the interviews, also scored a random sample of 15 of the assault transcripts. Scores for the two raters showed high agreement; for narrative disorganization score $r = .972$ ($p < .0005$); for experimenter-rated disorganization $r = .970$ ($p < .0005$).

### *Appraisal Measures*

Negative appraisals of intrusive memory symptoms were measured with a version of the Interpretation of PTSD Symptoms Inventory (IPSI; Clohessey & Ehlers, 1999; Dunmore et al., 1999, 2001; Steil & Ehlers, 2000). The IPSI has been shown to have good internal consistency in several studies of trauma survivors and to predict PTSD symptoms. The version used in the present study comprised seven items (e.g., "If I cannot control my thoughts about the assault, something terrible will happen"). Internal consistency for the present samples was Cronbach's $\alpha = .93$. In addition, participants described their appraisals of problems in recalling the assault on a new scale consisting of three items (e.g. "I must find it unbearable") with Cronbach's alpha = .79.

### *Procedure*

Participants completed the BDI, STAI, and TDQ in the week prior to the interview. All other measures were completed during an interview session, the mean duration of which was approximately 2 hr. In addition to the assessments described, the interview included unrelated cognitive and physiological measures to be reported elsewhere. Interviews were conducted by Sarah L. Halligan ($n = 43$) or Tanja Michael ($n = 38$).

### *Statistical Analyses*

Chi-square tests (categorical data) or analysis of variance (ANOVA; continuous data) were used to examine background and assault characteristics across the three groups. Group comparisons of main measures were carried out using multivariate analyses of variance (MANOVAs) for sets of related variables (i.e., cognitive processing during assault, trauma memory deficits, appraisals of trauma memories). Pairwise post hoc tests were carried out using Tukey's honestly significant difference test, or Dunnett's T3 post hoc test where Levene's test indicated unequal variances. Multivariate analyses of covariance were used to examine group differences in cognitive processing, memory, and appraisals while controlling for potential confounds.

## *Results*

### *Description of the Participant Groups*

Table 1 shows that the current, recovered, and no-PTSD groups were comparable in terms of demographic characteristics. The distribution of study information by Victim Support Centers precluded accurate monitoring of response rates, but they appeared to be low. Prior to the assault, 18.8% of the current PTSD group, 15.0% of the recovered PTSD group, and 13.8% of the no-PTSD group had sought psychiatric help, $\chi^2(2, N = 81) = 0.30$, *ns*. Following the assault, 65.6% of the current PTSD group, 40.0% of the recovered PTSD group, and 10.3% of the no-PTSD group sought psychiatric help, $\chi^2(2, N = 81) = 19.46$, $p < .0005$.

An ANOVA examined PTSD symptom change (i.e., PDS symptom scores at interview minus ratings of symptoms at 1-month postassault) in relation to group. There was a significant main effect of group, $F(2, 78) = 18.47$, $p < .0005$; participants in the recovered group reported more symptom reduction over time (symptom change $M = -17.3$, $SD = 7.8$) than participants in the current ($M = -7.4$, $SD = 10.8$) and no-PTSD groups ($M = -2.6$, $SD = 4.5$), all $p$s $< .001$. This finding supports the validity of the group distinction.

Assault characteristics are presented in Table 2. A mean of 55 weeks had elapsed between the assault and interview (range: 4 months–5 years). The composite measure of assault severity indicated no group differences. However, individuals in the current PTSD group were more likely to have experienced an assault involving a weapon. In addition, the current and recovered PTSD groups reported greater perceived threat to life/of serious injury and fear/terror than the no-PTSD group, all $p$s $< .02$.

### *Tests of the Hypotheses*

*Associations between cognitive processing and memory characteristics.* Zero-order correlations between cognitive processing and assault memory characteristics are reported in Table 3. As expected, dissociation, data-driven processing, and a lack of self-referent processing correlated significantly with the measures of memory disorganization and self-reported intrusive qualities of assault memories. In addition, the three cognitive-processing variables were highly intercorrelated ($r$s between .73 and .77).

*Group differences in cognitive processing during the assault.* Scores on the measures of cognitive processing during assault are reported for the three groups in Table 4. MANOVA was used to examine group differences in dissociation, data-driven, and lack of self-referent processing during the assault. There was a significant overall main effect of group, Pillai's Trace $F(6, 154) = 11.12$, $p < .0005$, and all univariate analyses were also significant (all $p$s $< .0005$). Pairwise post hoc comparisons showed group differences as expected for variables involved in the development of PTSD symptoms. Both the current PTSD group and the recovered PTSD group reported more dissociation and data-driven processing and a relative lack of self-referent processing during the assault than the no-PTSD group. The current PTSD group did not differ from the recovered group in dissociation and data-driven processing, but it

Table 1
*Demographic and Clinical Characteristics of the Cross-Sectional and Prospective Samples*

| | Cross-sectional sample | | | | | | | Prospective sample | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Current ($n$ = 32) | | Recovered ($n$ = 20) | | No PTSD ($n$ = 29) | | Analysis | PTSD ($n$ = 31) | | No PTSD ($n$ = 42) | | Analysis |
| Variable | $n$ | % | $n$ | % | $n$ | % | $\chi^2(2)$ | $n$ | % | $n$ | % | $\chi^2(1)$ |
| Gender | | | | | | | 3.29 | | | | | 0.45 |
| Female | 15 | 46.9 | 10 | 50.0 | 8 | 27.6 | | 15 | 48.4 | 16 | 40.5 | |
| Male | 17 | 53.1 | 10 | 50.0 | 21 | 72.4 | | 16 | 51.6 | 25 | 59.5 | |
| Marital status | | | | | | | 6.36 | | | | | 9.93** |
| Single | 12 | 41.4 | 14 | 70.0 | 17 | 63.0 | | 13 | 43.3 | 16 | 41.0 | |
| Married | 6 | 20.7 | 3 | 15.0 | 6 | 22.2 | | 4 | 13.3 | 17 | 43.6 | |
| Divorced | 11 | 37.9 | 3 | 15.0 | 4 | 14.8 | | 13 | 43.3 | 6 | 15.4 | |
| Employment | | | | | | | 6.64* | | | | | 1.52 |
| Not employed | 11 | 37.9 | 3 | 15.0 | 3 | 11.1 | | 9 | 30.0 | 7 | 17.5 | |
| Employed/studying | 18 | 62.1 | 17 | 85.0 | 24 | 88.9 | | 21 | 70.0 | 33 | 82.5 | |
| Race | | | | | | | 0.11 | | | | | 0.65 |
| Caucasian | 28 | 87.5 | 18 | 90.0 | 26 | 89.7 | | 27 | 90.0 | 38 | 95.0 | |
| Other | 4 | 12.5 | 2 | 10.0 | 3 | 10.3 | | 3 | 10.0 | 2 | 5.0 | |
| | $M$ | $SD$ | $M$ | $SD$ | $M$ | $SD$ | $F(2, 78)$ | $M$ | $SD$ | $M$ | $SD$ | $t(71)$ |
| Age (years) | 36.5 | 10.7 | 36.8 | 12.9 | 38.6 | 12.7 | 0.24 | 41.2 | 15.2 | 39.5 | 14.7 | 0.50 |
| Education (years) | 14.3 | 4.5 | 14.3 | 4.0 | 14.4 | 3.6 | 0.01 | 12.3 | 2.1 | 15.8 | 4.8 | 4.06*** |
| PDS (PTSD)[a] | 29.0 | 10.5 | 10.9 | 5.2 | 6.2 | 6.1 | 68.66*** | 28.6 | 8.0 | 9.3 | 6.0 | 11.83*** |
| BDI (depression)[a] | 22.1 | 10.5 | 9.3 | 7.5 | 5.4 | 4.1 | 34.20*** | 18.0 | 7.7 | 5.3 | 4.7 | 7.78*** |
| STAI-S (state anxiety)[a] | 42.1 | 9.2 | 31.5 | 6.2 | 29.5 | 10.1 | 17.26*** | 41.8 | 8.6 | 32.7 | 10.3 | 4.00*** |
| STAI-T (trait anxiety)[a] | 56.9 | 10.2 | 44.7 | 12.8 | 38.5 | 9.0 | 22.0*** | 54.0 | 12.4 | 39.2 | 9.8 | 5.83*** |

*Note.* PTSD = posttraumatic stress disorder; PDS = Posttraumatic Stress Diagnostic Scale; BDI = Beck Depression Inventory; STAI = State–Trait Anxiety Inventory.
[a] For the retrospective sample, participants in the current PTSD group differed significantly from participants in the recovered PTSD and no-PTSD groups ($p < .0005$, Dunnett's T3 post hoc test).
* $p < .05$. ** $p < .01$. *** $p < .001$.

reported a relative lack of self-referent processing, as indicated by a higher score on this questionnaire (see Table 4 for details).

*Group differences in trauma memory disorganization.* The mean length of narratives analyzed was $M = 93.6$ "chunks," $SD = 72.2$, and narrative length did not differ between the groups, $F(2, 70) = 0.2$. Mean self-reported disorganization, narrative disorganization, and global experimenter rating of disorganization scores are reported by group in Table 4. A MANOVA of the three indices of trauma memory disorganization showed an overall main effect of group, Pillai's Trace $F(6, 136) = 3.82$, $p = .001$. Univariate analyses indicated group differences for self-report, $p = .011$, narrative, $p = .002$, and experimenter rating, $p < .0005$, measures of disorganization. In accordance with the hypothesized pattern for factors involved in the development of PTSD, pairwise comparisons indicated that both the current and the recovered PTSD groups scored higher in terms of narrative and experimenter-rated disorganization than the no-PTSD group. For self-reported disorganization, only the current and no-PTSD groups differed significantly (Table 4).

*Group differences in persistent dissociation.* Group differences on the TDQ are also reported in Table 4. ANOVA indicated significant group differences in persistent dissociation after the assault, $F(2, 73) = 28.84$, $p < .0005$. As predicted for a maintaining factor, the current PTSD group reported greater persistent dissociation than the recovered and no-PTSD groups. In addition, the recovered group scored higher than the no-PTSD group. The expected pattern of group differences for a maintaining factor (current PTSD greater than recovered and no-PTSD) was found for the TDQ-factors Emotional Numbing, Confusion and Altered Time Sense, and Lability of Mood and Impulsivity, all $p$s $< .02$.

*Group differences in negative appraisals of trauma memories.* A MANOVA of negative appraisals of both trauma memory disorganization and intrusive memories showed a significant group effect, Pillai's Trace $F(4, 152) = 13.85$, $p < .0005$, as did univariate analyses for both of the scales, $p < .0005$ (mean scores are presented in Table 4). Post hoc testing indicated that, in accordance with the hypothesized pattern for maintaining factors, the current PTSD group reported more negative appraisals of their intrusive memories than the recovered PTSD group and the no-PTSD group. The recovered PTSD group also reported more negative interpretations than the no-PTSD group. For negative interpretations of memory disorganization, only the difference between the current and the no-PTSD groups was significant.

## *Are Group Differences in Cognitive Variables Independent of Stressor Severity?*

Multivariate analyses of covariance tested whether the group differences described above remained significant when differences in objective and subjective assault severity were controlled. In the first set of analyses, the composite measure of assault severity, perceived threat to life/physical integrity and fear/terror during the

Table 2
*Assault Characteristics for the Cross-Sectional and Prospective Samples*

| | Retrospective sample | | | | | | | Prospective sample | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Current ($n$ = 32) | | Recovered ($n$ = 20) | | No PTSD ($n$ = 29) | | Analysis | PTSD ($n$ = 31) | | No PTSD ($n$ = 42) | | Analysis |
| Variable | $n$ | % | $n$ | % | $n$ | % | $\chi^2(2)$ | $n$ | % | $n$ | % | $\chi^2(1)$ |
| Assault type | | | | | | | 4.8 | | | | | 0.18 |
| Physical | 27 | 84.4 | 18 | 90.0 | 29 | 100.0 | | 29 | 93.5 | 41 | 97.6 | |
| Sexual | 5 | 15.6 | 2 | 10.0 | 0 | 0 | | 2 | 6.5 | 1 | 2.4 | |
| Number of assailants | | | | | | | 1.33 | | | | | 0.07 |
| Single assailant | 23 | 71.9 | 14 | 70.0 | 17 | 58.6 | | 21 | 67.7 | 29 | 70.7 | |
| Multiple assailants | 9 | 28.1 | 6 | 30.0 | 12 | 41.1 | | 10 | 32.3 | 12 | 29.3 | |
| Weapon usage | | | | | | | 9.55** | | | | | <0.00 |
| Weapon not used | 17 | 53.1 | 18 | 90.0 | 23 | 79.3 | | 23 | 74.2 | 31 | 73.8 | |
| Weapon used | 15 | 46.9 | 2 | 10.0 | 6 | 20.7 | | 8 | 25.8 | 11 | 26.2 | |
| Injury severity | | | | | | | 3.54 | | | | | 3.00 |
| Mild | 1 | 3.1 | 2 | 10.0 | 3 | 10.3 | | 11 | 35.5 | 17 | 40.5 | |
| Moderate | 14 | 43.8 | 12 | 60.0 | 14 | 48.3 | | 13 | 41.9 | 10 | 23.8 | |
| Severe | 17 | 53.1 | 6 | 30.0 | 12 | 41.4 | | 7 | 22.6 | 15 | 35.7 | |
| | $M$ | $SD$ | $M$ | $SD$ | $M$ | $SD$ | $F(2, 78)$ | $M$ | $SD$ | $M$ | $SD$ | $t(71)$ |
| Time since (weeks) | 64.4 | 58.5 | 60.8 | 47.9 | 41.2 | 38.6 | 1.83 | 8.4 | 2.9 | 7.1 | 3.0 | 1.94 |
| Duration (min) | 13.9 | 28.8 | 7.5 | 9.0 | 4.7 | 4.7 | 1.88 | 14.4 | 27.1 | 5.9 | 7.4 | 1.69 |
| Global severity (0–12) | 5.8 | 2.2 | 4.8 | 1.9 | 5.1 | 1.7 | 2.10 | 5.5 | 2.1 | 5.2 | 2.0 | 0.72 |
| Perceived threat (0–100) | 50.4 | 32.9 | 52.6 | 32.7 | 22.6 | 24.0 | 8.52*** | 44.4 | 32.6 | 25.9 | 30.8 | 2.48* |
| Fear/terror (0–4) | 3.0 | 0.9 | 2.8 | 1.1 | 1.9 | 1.1 | 10.22*** | 3.2 | 0.74 | 2.3 | 1.07 | 4.36*** |

*Note.* PTSD = posttraumatic stress disorder.
* $p < .05$. ** $p < .01$. *** $p < .001$.

assault were included as covariates. The analyses were also repeated including weapon usage instead of the composite severity score, as this variable had shown a group difference. In both analyses, group differences in cognitive processing during assault, all $p$s $< .0005$, trauma memory deficits, all $p$s $< .015$, persistent dissociation, $p < .0005$, and appraisals of trauma memories, all $p$s $< .0005$, remained significant.

### *Additional Analyses*

An additional ANCOVA tested whether the distress participants experienced while recalling the assault accounted for group differences in narrative disorganization scores. This was not the case. Controlling for distress, there was still a significant main effect of group in relation to recall disorganization measures, Pillai's Trace $F(4, 138) = 3.63$, $p = .008$, with univariate effects for both the global experimenter rating, $p = .002$, and the narrative disorganization score, $p = .037$.

## *Discussion*

The results of the cross-sectional study were in line with hypotheses. All measures of peritraumatic cognitive processing—dissociation, data-driven processing, and lack of self-referent pro-

Table 3
*Associations of Cognitive Processing During the Assaults With Aspects of Assault Memory (Pearson's Correlation Coefficients)*

| Variable | Dissociation $r$ | Data driven $r$ | Lack of self-referent $r$ |
|---|---|---|---|
| Retrospective study ($N$ = 81) | | | |
| Narrative disorganization[a] | .48*** | .39*** | .41*** |
| Experimenter rated disorganization[a] | .45*** | .42*** | .46*** |
| Self-reported disorganization | .34** | .29** | .28* |
| Self-reported intrusive qualities | .66*** | .56*** | .65*** |
| Prospective study ($N$ = 73) | | | |
| Narrative disorganization[b] | .25* | .10 | .24* |
| Experimenter disorganization rating[b] | .30* | .33** | .32* |
| Self-reported disorganization | .34** | .20† | .36*** |
| Self-reported intrusive qualities | .56*** | .49*** | .56*** |

[a] $n$ = 73. [b] $n$ = 71.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4
*Scores on Assessments of Cognition and Memory for the Cross-Sectional Study: Means and Standard Deviations*

| Variable | PTSD group: Current ($n$ = 32) *M* | *SD* | Recovered ($n$ = 20) *M* | *SD* | No PTSD ($n$ = 29) *M* | *SD* | Pairwise post hoc tests: Current vs. recovered *p* | Current vs. no PTSD *p* | Recovered vs. no PTSD *p* |
|---|---|---|---|---|---|---|---|---|---|
| Assault cognitive processing | | | | | | | | | |
| Dissociation (0–4) | 2.0 | 1.1 | 1.4 | 0.7 | 0.5 | 0.6 | <.10 | <.001 | <.001 |
| Data driven (0–4) | 2.4 | 0.9 | 1.8 | 1.0 | 0.8 | 0.4 | *ns* | <.001 | <.01 |
| Lack of self-referent (0–4) | 1.9 | 0.9 | 0.9 | 0.8 | 0.2 | 0.3 | <.001 | <.001 | <.001 |
| Trauma memory disorganization | | | | | | | | | |
| Self-reported disorganization (0–4) | 1.2 | 1.2 | 0.9 | 0.8 | 0.4 | 0.6 | *ns* | <.01 | *ns* |
| Narrative disorganization[a] | 0.74 | 2.0 | 0.17 | 1.2 | −0.92 | 1.5 | *ns* | <.01 | <.05 |
| Experimenter rating (0–10)[a] | 5.1 | 2.6 | 4.8 | 2.6 | 2.2 | 2.3 | *ns* | <.001 | <.01 |
| Persistent dissociation (TDQ) | 72.1 | 27.1 | 47.3 | 29.0 | 24.1 | 13.0 | <.05 | <.001 | <.05 |
| Appraisals | | | | | | | | | |
| Memory deficits (0–4) | 1.2 | 1.1 | 0.6 | 0.8 | 0.1 | 0.2 | <.10 | <.001 | <.10 |
| Intrusive symptoms (0–4) | 1.8 | 1.0 | 0.7 | 0.7 | 0.1 | 0.1 | <.01 | <.001 | <.01 |

*Note.* PTSD = posttraumatic stress disorder. TDQ = Trait Dissociation Questionnaire.

cessing—were related to disorganization in trauma memory. In addition, cognitive-processing variables showed the pattern of group differences expected for factors involved in the development of PTSD, namely higher scores for both participants with current PTSD and those who had recovered from PTSD compared with participants who never developed PTSD. The same pattern of results was found for the rater-based assessments of trauma memory disorganization. The study also provided evidence that persistent dissociation and negative appraisals of trauma memories are involved in the maintenance of PTSD. As in previous research, perceived threat to life/physical integrity and fear/terror experienced during the assault were related to subsequent PTSD (e.g., March, 1993). However, group differences in the cognitive variables remained significant once subjective and objective assault severity were controlled for.

The results of the cross-sectional comparisons are compromised by the retrospective nature of some of the variables. Participants rated their reactions at the time of the assault after an elapsed period of, on average, 10 months. Prior research has indicated that memories of traumatic events are subject to distortion. In particular, current symptomatology may magnify perceptions of event severity and emotional reactions (Roemer, Litz, Orsillo, Ehlich, & Friedman, 1998; Schwarz, Kowalski, & McNally, 1993; Zoellner, Sacks, & Foa, 2001; Southwick, Morgan, Nicolaou, & Charney, 1997). Study 2 therefore attempted to replicate the findings of Study 1 using a prospective longitudinal design.

The longitudinal design of Study 2 allowed additional factors to be considered. Prospective research has demonstrated depressive disorder to be a common outcome following trauma exposure (Shalev et al., 1998), and the incidence of comorbid depression is high in individuals with PTSD. Although most studies observe significant elevations in depressive symptoms in conjunction with PTSD, few have investigated the relative contributions of predictors of PTSD to depressive symptoms (e.g., Mayou, Bryant, & Ehlers, 2001). Study 2 included repeated assessments of depressive as well as PTSD symptoms, therefore we were able to assess the specificity of our cognitive predictors to the development of PTSD.

Study 2 also examined additional aspects of memory disorganization in PTSD. First, we conducted a preliminary examination of whether traumatic memories in individuals with PTSD are qualitatively different from more general unpleasant memories in terms of both problems in explicit recall and intrusive qualities. The short time elapsed between the assault and assessment in Study 2 made it relatively easy to identify a second, nontraumatic memory from the same period of time with which to compare memory for the assault. In addition, 6 months following the first interview we reassessed memory for the assault, so that we could examine changes in memory in relation to symptom change. Prior research in a therapeutic setting has found reductions in memory disorganization to be associated with a positive response to exposure therapy (Foa et al., 1995).

## Study 2: Prospective Longitudinal Study

### *Method*

#### *Experimental Design and Participants*

Participant recruitment was as described for Study 1. Victims of physical or sexual assault were enrolled in the prospective study if they could be interviewed within 3 months or less of the assault. There was no overlap between the current sample and that of the retrospective study, all participants in the retrospective study having been assaulted more than 3 months prior to the interview. Seventy-three participants (32 women and 41 men) were eligible for and took part in the prospective study. Participants completed the first interview within 3 months of being assaulted ($M$ = 7.6 weeks, range: 2–12 weeks) and had follow-up assessments 3, 6, and 9 months later.

#### *Measures*

In addition to the measures described in Study 1, participants identified and described a second autobiographical event, which occurred around the

time of the assault and was somewhat unpleasant but nontraumatic. Participants completed the Trauma Memory Questionnaire with respect to this event as well as with respect to the assault.

### *Procedure*

The first interview was identical to that described for Study 1, with two exceptions: the inclusion of an assessment of memory for a nontraumatic event and the exclusion of the retrospective PDS ratings. At 3- and 9-month follow-up, participants completed the BDI and the PDS by mail. At 6-month follow-up, participants were reinterviewed, and in addition to completing the symptom measures, memory for the assault was reassessed. If participants were not available for interview at 6 months ($n = 4$), they completed the BDI, PDS, and assault memory questionnaire by mail. Participants were interviewed by Sarah L. Halligan ($n = 37$) or Tanja Michael ($n = 36$).

## *Results*

### *Description of the Participant Groups*

Mean age of the sample was 40.2, $SD = 14.8$ years (range: 18–74 years). Of the participants enrolled in the study, 1 completed only the first assessment, 5 completed two assessments, 12 completed three assessments, and 55 of the initial participants completed all follow-ups. For each of the follow-ups, the completers versus noncompleters were compared in terms of their initial PTSD symptom scores. Noncompleters had more initial symptoms than completers for the 9-month follow-up ($M = 24.64$, $SD = 12.68$, $n = 11$ vs. $M = 16.24$, $SD = 11.32$, $n = 62$, respectively; $t[71] = 2.23$, $p = .029$), but not at other assessments. As such selective dropout of symptomatic participants could lead to erroneous conclusions regarding changes in symptoms and symptom prediction, the data from the 9-month assessment were not analyzed.

Thirty-one participants met criteria for PTSD at one or more assessments, including 4 cases of delayed onset PTSD (PTSD group). Forty-two participants never met criteria for PTSD (no-PTSD group). Demographic and assault characteristics related to the development of PTSD were examined by comparing these two groups of participants (presented in Table 1). Individuals who met criteria for PTSD at one or more assessments were more likely to be divorced and had fewer years of education. No other demographic variables were related to the development of PTSD. Prior to the assault, 29% of the PTSD group and 33% of the no-PTSD group had sought psychiatric treatment. Subsequent to the assault, 23% of the PTSD group and 7% of the no-PTSD group sought treatment, Fisher's exact test $p = .082$.

### *Assault Characteristics*

Table 2 presents assault characteristics for the prospective sample. None of the objective assault characteristics assessed differentiated participants who met criteria for PTSD at one or more of the assessments from those who never developed PTSD. However, participants with PTSD perceived greater threat to life/physical integrity and experienced more fear/terror during the assault.

### *Symptom Change*

PTSD (PDS scores) and depressive (BDI scores) symptoms across the three assessments are illustrated in Figure 1. Repeated measures ANOVAs indicated that self-reported symptoms of both PTSD, Greenhouse–Geisser $F(1.5, 90.7) = 22.08$, $p < .0005$, and depression, Greenhouse–Geisser $F(1.8, 97.4) = 9.89$, $p < .0005$, decreased across assessments. About 30% of the participants met diagnostic criteria for PTSD at 3 and 6 months.

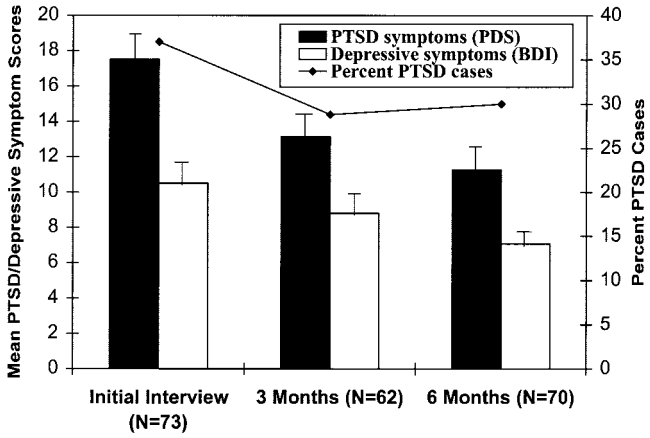


*Figure 1.* Change in self-reported symptoms of posttraumatic stress disorder (PTSD) and depression and number of PTSD cases with time since assault for the prospective sample: Error bars indicate standard errors. PDS = Posttraumatic Stress Diagnostic Scale; BDI = Beck Depression Inventory.

### *Tests of the Hypotheses*

*Associations between cognitive processing and trauma memory characteristics.* Zero-order correlations between cognitive processing and assault memory characteristics are reported in Table 3. With the exception of nonsignificant correlations for data-driven processing with both the narrative disorganization and self-reported disorganization scores (the latter was at trend level), the processing variables correlated with the measures of memory disorganization. In addition, all three processing variables correlated with self-reported intrusive qualities of assault memories.

Intercorrelations among the processing measures ranged between $r = .64$ and .79. Multiple regression analyses tested whether dissociation predicts variance in memory disorganization or intrusive memories over and above data-driven and lack of self-referent processing. This was not the case. The multiple correlations were similar to the correlations reported for individual processing styles (Table 3), and none of the processing styles contributed unique variance.

*Cognitive factors predicting PTSD symptoms.* Zero-order correlations between measures of cognitive processing during the assault and PTSD symptom scores on the PDS at each of the assessments are reported in Table 5. As expected, cognitive processing during assault, persistent dissociation, measures of deficits in trauma memory, and appraisals of trauma memories were significantly correlated with PTSD symptoms both concurrently and prospectively. Of the TDQ-factors, Emotional Numbing ($r = .47$), Confusion and Altered Time Sense ($r = .45$), and Lability of Mood and Impulsivity ($r = .56$), showed the highest correlations with PTSD symptom severity at 6 months, all $p$s $< .0005$.

Table 5
*Correlations Between Cognitive Measures and Symptoms for the Prospective Study*

| Variable | PTSD symptoms (PDS) Initial ($n$ = 73) $r$ | PTSD symptoms (PDS) 3 month ($n$ = 62) $r$ | PTSD symptoms (PDS) 6 month ($n$ = 70) $r$ | Depressive symptoms (BDI) Initial ($n$ = 68) $r$ |
|---|---|---|---|---|
| Cognitive processing | | | | |
| Dissociation | *.51**** | *.62**** | *.55**** | .21 |
| Data driven | *.40**** | *.45**** | *.38**** | .31* |
| Lack of self-referent | *.59**** | *.62**** | *.55**** | .45*** |
| Persistent dissociation | .54*** | *.55**** | *.53**** | .61*** |
| Trauma memory deficits | | | | |
| Self-reported disorganization | .29* | *.48**** | *.40*** | .28* |
| Narrative disorganization[a] | .45*** | *.49**** | *.43**** | .42*** |
| Experimenter disorganization rating[a] | .38** | *.44*** | *.49**** | .34** |
| Appraisals | | | | |
| Memory deficits | .58*** | *.63**** | *.53**** | .53*** |
| Intrusive symptoms | *.65**** | *.67**** | *.62**** | .59*** |

*Note.* Italicized correlations are still significant at the $p < .05$ level, once BDI scores at that time point are controlled for using partial correlation. PTSD = posttraumatic stress disorder; PDS = Posttraumatic Stress Diagnostic Scale; BDI = Beck Depression Inventory.
[a] Narratives could not be recorded for 2 participants. For the narrative disorganization score: initial $N$ = 71, 3 months $n$ = 60, 6 months $n$ = 69.
* $p < .05$. ** $p < .01$. *** $p < .001$.

One could argue that the correlations between memory disorganization and dissociation measures and PTSD symptoms may be inflated because amnesia and some aspects of dissociation are included among the symptoms of PTSD. To rule out this possibility, we repeated correlations using adjusted PDS scores that excluded the corresponding symptom items (for memory disorganization, not being able to remember an important part of the event; for dissociation, feeling distant or cut off from others and feeling emotionally numb). The removal of these items did not significantly or systematically reduce the reported correlations (maximum reduction in $r = .03$).

One could also argue that negative interpretations of memory symptoms are an epiphenomenon of more severe symptoms and predict PTSD severity at follow-up because they reflect higher initial symptom levels. This was not the case. Partial correlations examined the association between negative interpretations and 6-month PTSD symptom scores while controlling for initial symptom levels. Negative appraisals of both trauma memory deficits, partial $r(64) = 0.31$, $p = .012$, and intrusive symptoms, partial $r(64) = 0.27$, $p = .026$, still significantly predicted 6-month symptom levels once initial symptom levels were controlled for, although the strength of the associations was reduced.

*Regression analyses.* Hierarchical multiple regression analysis tested the hypotheses that (a) cognitive processing during assault, persistent dissociation, deficits in trauma memory, and appraisals of memory predict PTSD symptoms over and above assault severity; (b) persistent dissociation predicts over and above cognitive processing at the time of the assault; and (c) appraisals of trauma memories predict over and above cognitive processing and trauma memory measures. By adopting this hierarchical analysis, rather than simply examining the relative predictive power of individual and often overlapping measures, we tested whether successive levels of the proposed model predicted unique variance in PTSD symptoms. The results are summarized in Table 6. Trauma severity measures (composite score of objective trauma severity, perceived threat to life/physical integrity and fear/terror) explained 22% of the variance of PTSD severity at 6 months. When measures of cognitive processing, trauma memory, and appraisals were included in the regression, the amount of variance explained rose substantially to 71%. Consistent with the predictions, persistent dissociation at initial assessment predicted an additional 8% of the variance over and above the percentage explained by measures of trauma severity, trauma memory deficits, and cognitive processing during the assault. The appraisal measures contributed a further 7% of the predicted variance, over and above all other cognitive predictors and the trauma severity measures. In the final model, persistent dissociation, disorganization of trauma narratives, and appraisal of intrusive symptoms predicted unique variance of PTSD symptoms at 6 months. Repeating the analysis including demographic variables that were related to the development of PTSD in the first step (i.e., marital status and years of education) did not alter the findings.

### *Associations With Depressive Symptomatology*

Correlational analyses indicated significant associations between PTSD symptoms and depressive symptoms, as assessed by the BDI, at all three time points; postassault $r(68) = .75$, $p < .0005$; 3-month follow-up $r(61) = .60$, $p < .0005$; 6-month follow-up $r(69) = .60$, $p < .0005$. There were also significant correlations between each of the cognitive assessments and BDI scores; correlations for the first assessment are reported in Table 5. To assess whether cognitive factors uniquely contribute to PTSD symptoms, independently of comorbid depressive symptoms, we

Table 6
*Hierarchical Regression Analysis, Prospective Study: Predicting PTSD Severity at 6 Months After Initial Assessment*

| Variable entered | Model | | | Step | | | | Step 5 |
|---|---|---|---|---|---|---|---|---|
| | $R^2$ | $F$ | $df$ | $\Delta R^2$ | $\Delta F$ | $df$ | $p$ | $\beta$ Coefficient |
| Step 1: Stressor severity measures | .22 | 5.26 | 3, 55 | .22 | 5.26 | 3, 55 | .003 | |
| Objective Severity Composite | | | | | | | | .09 |
| Perceived threat to life/of serious injury | | | | | | | | .07 |
| Fear during assault | | | | | | | | .11 |
| Step 2: Assault cognitive processing | .40 | 5.75 | 6, 52 | .18 | 5.07 | 3, 52 | .004 | |
| Peritraumatic dissociation | | | | | | | | .23 |
| Data driven processing | | | | | | | | −.17 |
| Lack of self-referent processing | | | | | | | | .06 |
| Step 3: Persistent dissociation | .48 | 6.80 | 7, 51 | .08 | 8.27 | 1, 51 | .006 | .21* |
| Step 4: Trauma memory disorganization | .64 | 8.56 | 10, 48 | .16 | 7.04 | 3, 48 | .001 | |
| Narrative disorganization score | | | | | | | | .31* |
| Experimenter disorganization rating | | | | | | | | −.02 |
| Self-reported memory deficits | | | | | | | | −.06 |
| Step 5: Appraisals of trauma memory | .71 | 9.24 | 12, 46 | .07 | 5.17 | 2, 46 | .009 | |
| Appraisals of memory deficits | | | | | | | | .12 |
| Appraisals of intrusions | | | | | | | | .31* |

*Note.* PTSD = posttraumatic stress disorder.
* $p < .05$.

carried out partial correlations controlling for BDI scores. The majority of cognitive factors still significantly predicted PTSD symptoms once BDI scores were controlled for (Table 5).

### *Additional Analyses of Memory Characteristics*

Memories of the assault were compared with memories of a nontraumatic unpleasant event in terms of self-reported disorganization and intrusive characteristics, for individuals who met PTSD criteria at one or more assessments (PTSD group) versus those who never met criteria for PTSD (no-PTSD group). A Group (PTSD vs. no PTSD) × Memory (assault vs. nontrauma memory) repeated measures ANOVA indicated a significant main effect of memory type in relation to self-reported intrusive characteristics, $F(1, 69) = 22.35$, $p < .0005$, and a significant Group × Memory interaction, $F(1, 69) = 8.82$, $p = .004$. Similarly, repeated measures ANOVA (Group × Memory) indicated a significant main effect of memory type in relation to self-reported disorganization, $F(1, 70) = 9.35$, $p = .003$, and a significant Group × Memory interaction, $F(1, 70) = 9.35$, $p = .007$. Relative to nontrauma memories, assault memories were rated as being both more intrusive (nontrauma $M = 0.98$, $SD = 1.00$; assault $M = 1.50$, $SD = 0.95$) and more disorganized (nontrauma $M = 0.42$, $SD = 0.56$; assault $M = 0.69$, $SD = 0.84$). Importantly, these differences between trauma and nontrauma memory ratings were primarily present in individuals who developed PTSD versus those who did not develop PTSD. Mean differences in ratings for assault versus nontrauma memories were as follows: for intrusive qualities, PTSD mean difference = 0.92, $SD = 1.18$, non-PTSD mean difference = 0.21, $SD = 0.83$; for memory disorganization, PTSD mean difference = 0.59, $SD = 1.07$, non-PTSD mean difference = 0.03, $SD = 0.63$.

We also explored whether changes in assault memory characteristics were related to change in PTSD symptoms. Assault memory disorganization measured at 6 months remained significantly correlated with PTSD symptom severity (self-reported disorganization $r = .32$, narrative disorganization $r = .42$, experimenter disorganization rating $r = .59$). However, for none of the measures was the change in disorganization from initial assessment to 6 months related to change in PTSD symptom severity.

### *Additional Analyses of Cognitive-Processing Measures*

Studies 1 and 2 both found dissociation, data-driven processing, and self-referent processing to be highly intercorrelated, suggesting the possibility of data reduction. A principal axis factor analysis with varimax rotation was therefore conducted using all participants ($N = 154$). The scree plot suggested a three-factor solution. The first factor could be interpreted as measuring derealization, depersonalization, and emotional numbing. Items from the SDQ and the Lack of Self-Referent Processing Scale loaded highly on this factor. The second factor could be interpreted as measuring a lack of a time perspective and inability to relate the trauma to one's life. Again, items from the dissociation questionnaire and the Lack of Self-Referent Processing Scale loaded highly on this factor. The third factor could be interpreted as measuring the individual's inability to comprehend and take in what was happening during the trauma. One item from the dissociation questionnaire ("being in a daze") and items from the Data-Driven Processing Scale loaded highly on this factor.

## *Discussion*

Study 2 extended the results of the cross-sectional comparison with a prospective longitudinal design. It demonstrated that cognitive processing during trauma (dissociation, data-driven processing, and lack of self-referent processing) is related to trauma memory disorganization and predicts concurrent and subsequent PTSD symptoms. The prospective study also confirmed the role of disorganized trauma memories in predicting PTSD symptoms both concurrently and prospectively. As expected, cognitive processing and memory measures predicted variance in PTSD symptoms over

and above that which could be explained by stressor severity measures.

In addition, Study 2 provided preliminary evidence that trauma memories are qualitatively different from nontrauma unpleasant memories, particularly for individuals who develop PTSD. The latter comparison was made using a self-report measure of memory characteristics; it would be desirable to extend these findings to analyses of narratives.

Although the present study confirmed the association of disorganized trauma memories and PTSD symptoms both at initial assessment and 6 months later, it did not replicate the relationship between recovery and the development of more coherent memories that was reported for individuals undergoing exposure therapy (Foa et al., 1995). Several factors may have contributed to this discrepancy. One consideration is a relatively smaller range of change in the present study. Exposure therapy involves describing the trauma in detail many times and is therefore likely to produce a greater change in the trauma narratives than that observed in our naturalistic follow-up study. At the same time, degree of symptom change was also relatively small in the present, nonclinical sample; the mean change in PTSD symptom severity over the 6-month assessment period was 6% and the maximum decrease 33%. The majority of patients receiving exposure respond with at least 50% change in PTSD severity. A second possibility is that recovery from PTSD is specifically related to the reorganization of those parts of the trauma memory that are linked to intrusions, rather than to overall memory structure; a more detailed analysis of the trauma memory may provide a clearer picture. Third, during exposure, associations between symptom reduction and memory coherence may be inflated by a mutual dependence on patient compliance with in-therapy exposure instructions and memory rehearsal homework (Gray & Lombardo, 2001). Finally, change in memory disorganization may be necessary but not sufficient to bring about symptom reduction. Accompanying changes in appraisals of the trauma and its sequelae may be essential. To the extent that repeated reliving and therapeutic discussion during exposure therapy assist patients in recasting their experiences (e.g., realizing that they were not to blame for the trauma following a detailed examination of what happened), the correlation between changes in memory organization and changes in PTSD symptoms observed in Foa et al.'s (1995) treatment study may have been inflated by simultaneous changes in appraisals.

The prospective study provided strong evidence to support the hypothesized role of persistent dissociation and negative interpretations of trauma memories in maintaining PTSD symptoms. As in Murray et al.'s (2002) study of motor vehicle-accident survivors, persistent dissociation predicted chronic PTSD symptoms over and above peritraumatic dissociation and other cognitive processing. Negative interpretations of trauma memory characteristics predicted a significant proportion of the variance in chronic PTSD symptoms, over and above that explained by stressor severity and other cognitive variables, underlining their role as maintaining factors. These findings replicate and extend earlier findings from prospective studies of assault and motor vehicle-accident survivors (Dunmore et al., 2001; Ehlers et al., 1998). In addition to supporting the role of negative interpretations of intrusive memories, the present study found that negative interpretations of trauma memory disorganization predict chronic PTSD.

## General Discussion

### *Cognitive Processing During Trauma and Persistent Dissociation*

The results of both studies confirmed the predicted association between cognitive processing during assault and the development of disorganized trauma memories. Several prior studies have found dissociation during and after trauma to be associated with the development of PTSD. However, the construct of dissociation is relatively complex (e.g., Lynn & Rhue, 1994); determining which components of dissociation contribute to the development of PTSD, and by what mechanism, would be a significant conceptual development. The present studies contributed relevant information to these questions.

First, peritraumatic dissociation was highly correlated with data-driven processing and self-referent processing, linking dissociation closer to concepts from experimental psychology (Ehlers & Clark, 2000). A factor analysis examining peritraumatic processing data from both studies suggested three factors; dissociation and self-referent processing items contributed to the first two of these factors, and dissociation and data-driven processing items to the third factor, further supporting the hypothesized conceptual overlap. Future research may support the validity of the factors derived. Nevertheless, the results supported our contention that dissociation may be recast in terms of concepts derived from experimental psychology research, as none of the items from the SDQ represented a separate factor. Dissociation may in part lead to disorganized trauma memories because it is characterized by superficial processing of the trauma and a lack of self-reference. Notably, when multiple regression analysis was used to examine peritraumatic dissociation, data-driven and self-referent processing measures conjointly in predicting trauma memory characteristics, dissociation did not contribute unique variance.

Second, not all aspects of persistent dissociation were equally important in predicting chronic PTSD. The TDQ-factors, Emotional Numbing, Confusion and Altered Time Sense, and Lability of Mood and Impulsivity, showed the closest relationship with chronic PTSD across both studies. Although labile mood may be a measure of the initial severity of PTSD symptoms, emotional numbing and confusion are likely to impede subsequent processing of the trauma.

### *Trauma Memories*

The current research replicated prior reports that trauma memories are more disorganized in individuals with trauma-related symptomatology (Harvey & Bryant, 1999) and that degree of disorganization predicts subsequent PTSD symptoms (Amir et al., 1998; Murray et al., 2002). Furthermore, the findings replicated across a variety of measures. Prior studies have mainly used narrative assessments of memory disorganization: A potential limitation of this approach is that distress or avoidance during narrative recall could lead to incoherent accounts in the absence of actual memory problems, inflating the association between memory disorganization and symptoms. We ruled out this possibility by including a self-report measure of memory disorganization and by conducting analyses of narrative disorganization while controlling for distress.

Although we addressed some limitations of prior research by including a nontrauma comparison memory and multiple indices of memory fragmentation, potential problems remain. Importantly, although we controlled for level of education, we did not directly assess intelligence. Lower intelligence has been associated with the development of PTSD (Macklin et al., 1998) and has been found to explain differences in the reading level of written trauma narratives in students with and without PTSD (Gray & Lombardo, 2001). Speculatively, intelligence could affect encoding of traumatic material by causing individual differences in cognitive processing of stressful events. Differences in IQ cannot account for the fact that individuals with PTSD rated their assault memories as being more disorganized than their nontraumatic memories in the current study. However, we cannot rule out the possibility that IQ differences mediated the associations between *narrative* disorganization and PTSD symptoms, as we did not compare actual narratives for assaults versus nontraumatic events.

### *Appraisals of Trauma Memories*

The current studies provided strong support for the role of negative interpretations of trauma memories in maintaining PTSD: They contribute to a growing literature showing the relevance of such appraisals to chronic PTSD following a range of different traumas (Clohessy & Ehlers, 1999; Dunmore et al., 1999, 2001; Ehlers et al., 1998; Steil & Ehlers, 2000). In line with previous prospective studies, negative interpretations predicted subsequent PTSD severity over and above initial PTSD symptom levels (Dunmore et al., 2001; Ehlers et al., 1998). The present research extends previous findings by demonstrating that negative interpretations of memory disorganization, as well as intrusive memories, predict chronic PTSD symptoms. Furthermore, negative appraisals were found to predict PTSD symptoms even once actual memory characteristics and depressive symptoms were controlled for.

### *Contribution of Cognitive Variables to the Prediction of PTSD Symptoms*

The present studies clearly demonstrated that cognitive processing during trauma, trauma memory disorganization, persistent dissociation, and negative interpretations of trauma memories all predict PTSD symptoms over and above objective and subjective measures of stressor severity. Overall, the cognitive predictors and stressor variables taken at initial assessment predicted 71% of the variance of PTSD severity at 6 months. The high accuracy of the prediction compares favorably with other studies. For example, in a cross-sectional study of motor vehicle-accident survivors 38% of the variance in PTSD was predicted with 8 psychological and stressor variables selected from a set of 38 potential predictors (Blanchard et al., 1996). In the present study, each of the sets of variables examined contributed unique variance to PTSD symptomatology. The results support theoretical models of PTSD that emphasize the roles of cognitive processing and trauma memory characteristics (e.g., Brewin et al., 1996; Ehlers & Clark, 2000; Foa et al., 1989) and of cognitive maintaining factors in PTSD (Ehlers & Clark, 2000).

The current studies have some important limitations. First, the extent to which cognitive processing can be inferred from an individual's introspections is questionable. In the absence of an alternative approach, further efforts to validate the self-report measures used through experimental research would improve the strength of our conclusions. Second, although the prospective study demonstrated that our cognitive factors have the power to predict subsequent PTSD symptomatology, conclusive evidence of causality requires a demonstration that manipulating the variable of interest implements change in symptoms.

### *Implications*

The high predictive power of the cognitive measures in the present studies may have practical as well as theoretical implications. First, the variables assessed in the present studies may provide useful information in selecting trauma-exposed individuals who will need psychological intervention after traumatic events. Second, they support the use of therapeutic techniques that are designed to change negative appraisals of intrusive memories and to reverse maintaining cognitive strategies that prevent emotional processing, such as persistent dissociation (Ehlers & Clark, 2000). Third, they support a multilevel conceptualization of the cognitive processes involved in the development and maintenance of PTSD. To the extent that an individual shows a greater or lesser degree of impairment at each level, the therapeutic intervention they receive may require a corresponding change in emphasis.

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